

Claims

I claim:

- 5 ~~Sub 1~~ A network device-based method comprising:  
determining, upon receiving acknowledgement  
of receipt of new data, an excess number of  
duplicate acknowledgements based upon a count of  
consecutive duplicate acknowledgement packets;  
10 taking a network packet transmission recovery  
action based upon said excess number of duplicate  
acknowledgements; and  
storing said excess number of duplicate  
acknowledgements as a number of duplicate  
15 acknowledgements.
2. The network device-based method of Claim 1  
further comprising:  
determining whether a congestion window is  
20 inflated prior to said determining an excess  
number of duplicate acknowledgements.
3. The network device-based method of Claim 1  
wherein said taking a network packet transmission  
25 recovery action further comprises:  
deflating a congestion window upon said value  
of said excess number of duplicate  
acknowledgements in bytes being less than a number  
of bytes in a transmission control protocol sender  
30 segment.
4. The network device-based method of Claim 1  
wherein said taking a network packet transmission  
recovery action further comprises:  
35 optimizing a size of a congestion window to  
match a reduction in a quantity of unacknowledged  
data upon said excess number of duplicate

acknowledgements being greater than a TCP sender segment.

5        5. The network device-based method of Claim 1  
      wherein said taking a network packet transmission  
      recovery action further comprises:

          comparing said excess number of duplicate  
          acknowledgements with a duplicate acknowledgement  
          threshold.

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      6. The network device-based method of Claim 5  
      wherein said taking a network packet transmission  
      recovery action further comprises:

          performing a fast retransmit upon said  
15        comparing said excess number of duplicate  
          acknowledgements with a duplicate acknowledgement  
          threshold indicating that said excess number of  
          duplicate acknowledgements is greater than or  
          equal to said duplicate acknowledgement threshold.

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      7. The network device-based method of Claim 6,  
      wherein said taking a network packet transmission  
      recovery action further comprises:

          analyzing a size of a congestion window.

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      8 The network device-based method of Claim 7,  
      wherein said taking a network packet transmission  
      recovery action further comprises:

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          resizing said congestion window upon said  
          analyzing said size of said congestion window  
          showing said size is greater than a predefined  
          size.

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      9. The network device-based method of Claim 5,  
      wherein said taking a network packet transmission  
      recovery action further comprises:

analyzing a size of a congestion window upon  
said comparing said excess number of duplicate  
acknowledgements with a duplicate acknowledgement  
threshold indicating that said excess number of  
5 duplicate acknowledgements is less than said  
duplicate acknowledgement threshold.

10 The network device-based method of Claim 9,  
wherein said taking a network packet transmission  
10 recovery action further comprises:

resizing said congestion window upon said  
analyzing said size of said congestion window  
showing said size is greater than a predefined  
size.

15 11. The network device-based method of Claim 1  
wherein said method is included in Transmission Control  
Protocol congestion avoidance.

20 12. A network device-based method comprising:  
determining, upon receiving acknowledgement  
of receipt of new data, an excess number of  
duplicate acknowledgements based upon a count of  
consecutive duplicate acknowledgement packets;

25 deflating a congestion window upon said value  
of said excess number of duplicate  
acknowledgements being less than a transmission  
control protocol sender segment;

30 optimizing a size of said congestion window  
to match a reduction in a quantity of  
unacknowledged data upon said excess number of  
duplicate acknowledgements being greater than a  
transmission control protocol sender segment; and

35 storing said excess number of duplicate  
acknowledgements as a number of duplicate  
acknowledgements.

13. The network device-based method of Claim 12 further comprising:

5 comparing said excess number of duplicate acknowledgements with a duplicate acknowledgement threshold upon said excess number of duplicate acknowledgements in bytes being greater than a number of bytes in a TCP sender segment.

10 14. The network device-based method of Claim 13 further comprising:

15 performing a fast transmit upon said comparing said excess number of duplicate acknowledgements with a duplicate acknowledgement threshold indicating that said excess number of duplicate acknowledgements is greater than or equal to said duplicate acknowledgement threshold.

20 15. The network device-based method of Claim 14 further comprising:

analyzing a size of said congestion window.

25 16 The network device-based method of Claim 15 further comprising:

resizing said congestion window upon said analyzing said size of said congestion window showing said size is greater than a predefined size.

30 17. The network device-based method of Claim 12 further comprising:

35 analyzing a size of said congestion window upon said comparing said excess number of duplicate acknowledgements with a duplicate acknowledgement threshold indicating that said excess number of duplicate acknowledgements is less than said duplicate acknowledgement threshold.

18 The network device-based method of Claim 17  
further comprising:

5 resizing said congestion window upon said  
analyzing said size of said congestion window  
showing said size is greater than a predefined  
size.

19. The network device-based method of Claim 12  
wherein said method is included in Transmission Control  
10 Protocol congestion avoidance.

20. A transmission control protocol method  
comprising:

15 performing a TCP fast recovery process; and  
performing a TCP fast recovery extended  
process upon receiving acknowledgement of receipt  
of new data in said TCP fast recovery process.

21. A network device comprising:  
20 a processor; and  
a memory coupled to said processor, and  
storing a fast recovery extended method wherein  
upon execution of said fast recovery extended  
method by said processor a fast recovery process  
25 is extended.

22. The network device of Claim 21, wherein said  
fast recovery extended method further comprises:

30 determining, upon receiving acknowledgement  
of receipt of new data by said network device, an  
excess number of duplicate acknowledgements based  
upon a count of consecutive duplicate  
acknowledgement packets;

35 taking a network packet transmission recovery  
action based upon said excess number of duplicate  
acknowledgements; and

storing said excess number of duplicate acknowledgements in said memory as a number of duplicate acknowledgements.

5        23. The network device of Claim 22, wherein said fast recovery extended method further comprises:

determining whether a congestion window is inflated prior to said determining an excess number of duplicate acknowledgements.

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24. The network device of Claim 22, wherein said taking a network packet transmission recovery action further comprises:

15        deflating a congestion window upon said value of said excess number of duplicate acknowledgements in bytes being less than a number of bytes in a transmission control protocol sender segment.

20        25. The network device of Claim 22 wherein said taking a network packet transmission recovery action further comprises:

25        optimizing a size of a congestion window to match a reduction in a quantity of unacknowledged data upon said excess number of duplicate acknowledgements being greater than a TCP sender segment.

30        26. The network device of Claim 22 wherein said taking a network packet transmission recovery action further comprises:

comparing said excess number of duplicate acknowledgements with a duplicate acknowledgement threshold.

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27. The network device of Claim 26 wherein said taking a network packet transmission recovery action further comprises:

performing a fast retransmit upon said  
comparing said excess number of duplicate  
acknowledgements with a duplicate acknowledgement  
threshold indicating that said excess number of  
5 duplicate acknowledgements is greater than or  
equal to said duplicate acknowledgement threshold.

28. The network device of Claim 27, wherein said  
taking a network packet transmission recovery action  
10 further comprises:

analyzing a size of a congestion window.

29. The network device of Claim 28, wherein said  
taking a network packet transmission recovery action  
15 further comprises:

resizing said congestion window upon said  
analyzing said size of said congestion window  
showing said size is greater than a predefined  
size.

30. The network device of Claim 26, wherein said  
taking a network packet transmission recovery action  
further comprises:

analyzing a size of a congestion window upon  
25 said comparing said excess number of duplicate  
acknowledgements with a duplicate acknowledgement  
threshold indicating that said excess number of  
duplicate acknowledgements is less than said  
duplicate acknowledgement threshold.

31. The network device of Claim 30, wherein said  
taking a network packet transmission recovery action  
further comprises:

resizing said congestion window upon said  
35 analyzing said size of said congestion window  
showing said size is greater than a predefined  
size.

32. The network device of Claim 22 wherein said method is included in Transmission Control Protocol congestion avoidance.

5 33. A programmable memory including a fast recovery extended method wherein said fast recovery extended method upon execution comprises:

determining, upon receiving acknowledgement  
of receipt of new data, an excess number of  
10 duplicate acknowledgements based upon a count of  
consecutive duplicate acknowledgement packets;  
taking a network packet transmission recovery  
action based upon said excess number of duplicate  
acknowledgements; and  
15 storing said excess number of duplicate  
acknowledgements as a number of duplicate  
acknowledgements.

20 34. A network device comprising:  
means for performing a TCP fast recovery  
process; and  
means for performing a TCP fast recovery  
extended process upon receiving acknowledgement of  
receipt of new data in said TCP fast recovery  
25 process.

30 35. A network device comprising:  
means for determining, upon receiving  
acknowledgement of receipt of new data, an excess  
number of duplicate acknowledgements based upon a  
count of consecutive duplicate acknowledgement  
packets;  
means for taking a network packet  
transmission recovery action based upon said  
35 excess number of duplicate acknowledgements; and  
means for storing said excess number of  
duplicate acknowledgements as a number of  
duplicate acknowledgements.